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Chew on This: Self-Control, Eating, and Mindfulness

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Abstract

The proportion of people who are overweight or obese has reached pandemic levels. In 2013, the American Heart Association reported that 23.9 million children and 154.7 million adults were overweight or obese (Go et al., 2013). One factor highly relevant to this problem is self-control, which is the ability to regulate our actions in pursuit of goals and to bring them in line with various standards (Baumeister, Vohs, & Tice, 2007). Individuals low in self-control may be more likely to overeat. For example, Vohs and Heatherton (2000) demonstrated that placing tempting and available snack food in close proximity to dieters resulted in greater subsequent consumption of ice cream compared to nondieters due to depletion of their self-control resources. Mindfulness meditation is an intervention shown to restore depleted self-control (Friese, Messner, & Schaffner, 2012). Furthermore, mindful eating is another promising means to combat overweight and obesity. Mindful eating is a non-judgmental awareness of physical and emotional experiences that arise when eating or when in an environment where food is present (Framson et al., 2009). Framson and colleagues (2009) stated that the practice of eating mindfully increases awareness of why one eats and thus may be beneficial in weight loss or weight management. Thus, the purpose of the present study is to examine the effectiveness of a brief mindfulness meditation intervention in restoring participants' self-control and increasing mindful eating behaviors. This study consists of a 2 (self-control depletion or no self-control depletion) x 2 (mindfulness meditation intervention or distractor task) experimental design. First, participants will complete an emotion suppression task, with those in the self-control depletion condition instructed to suppress their emotions, and those in the no self-control depletion condition instructed to allow their emotions to arise naturally. Next, participants in the mindfulness meditation intervention will listen to a guided meditation audio clip, while those in the distractor task condition will complete a series of connect-the-dot figures. Finally, all participants will be placed in a waiting room scenario where candy will be available, after which their self-reported mindful eating will be assessed, as well as the amount of candy consumed. It is hypothesized that participants whose self-control is not depleted and those who receive the mindfulness meditation intervention will eat less and report being more mindful while eating during this waiting room scenario. Data collection is ongoing, but early pilot-testing of the emotion suppression task indicated that it was effective in depleting participants' self-control, as participants who were instructed to suppress their emotions scored significantly lower on a cognitive self-control task than participants in the non-suppression group $t(18) = 1.85$, $p = .046$. Data collection is expected to be completed by December, 2014.

Keywords: Mindfulness, Self-control, Eating

1. Introduction

The 2013 American Heart Association *Overweight & Obesity* report indicated that 23.9 million children ages 2 to 19 years and 154.7 million adults age 20 years or older were overweight or obese.[1] The current annual costs associated with the adolescent overweight and obesity health crisis alone have been estimated to be $254 billion, with $208

billion attributed to lost productivity secondary to premature illness and death, and $46 billion attributed to direct medical costs.[2] Regarding the physical health consequences associated with overweight and obesity, one meta-analysis examining comorbidities (i.e., simultaneously occurring chronic diseases) linked with overweight and obesity found statistically significant increased relative risks for type II diabetes, various cancers (e.g., colorectal and kidney cancers), a number of cardiovascular diseases (e.g., pulmonary embolism and coronary artery disease), and other disorders (e.g., asthma and osteoarthritis).[3] Highlighting the impending economic strain associated with this health crisis, one group of researchers predicted that current trends in the increasing prevalence of obesity could result in associated healthcare costs reaching $861 to $957 billion by 2030, accounting for 16 to 18 percent of all U.S. health expenditures.[4] Furthermore, it has been noted that individuals who are overweight or obese face bias, prejudice, and discrimination as part of their everyday lives, which may result in negative psychological (e.g., onset of depression) and social (e.g., economic hardship and isolation) outcomes.[5]

It is clear, though, that many overweight and obese Americans are trying to lose weight, with the press release for the recently published report "The U.S. Weight Loss Market: 2014 Status Report & Forecast" revealing that the 2013 weight loss market was estimated to be worth $60.5 billion.[6] However, despite this financial investment in the diet industry, there is no scientific evidence in support of dieting as a means for sustained weight loss, with the majority of dieters instead failing to achieve lasting weight loss.[7] In *Savor*, Thich Nhat Hanh, a Zen Buddhist Master, reflects on what can be done regarding the pandemic of overweight and obesity, stating that "the Buddha said that if we know how to look deeply into our suffering and recognize what feeds it, we are already on the path to emancipation."[8] Among other factors, the consumption of sugar-sweetened beverages, the prevalence of sedentary behaviors, and mindless eating have been identified as contributing to the global overweight and obesity crisis.[9]

1.1. consumption of sugar-sweetened beverages

One factor that has been linked to obesity is the consumption of sugar-sweetened beverages (SSB), such as soft drinks, with survey data from 18 U.S. states revealing that 26.3% of adults consume one or more daily servings of regular soda and/or fruit drinks, with SSB consumption most prevalent among 18-34 year olds (24.5% for regular soda and 16.6% for fruit drinks).[10] Regarding SSB consumption and associated adverse health outcomes among children, a 19-month observational study among 548 schoolchildren (M_{Age} = 11.70 years, SD_{Age} = 0.80 years) revealed that 57% of these children increased their SSB consumption over the course of the study and that for each additional daily serving of SSB, both body mass index and the odds ratio of becoming obese increased significantly.[11]

1.2. sedentary behaviors

A second factor that is relevant to the American overweight and obesity crisis is the prevalence of sedentary behaviors. Watching television is one sedentary behavior that has been explored for a potential link to obesity risk. For example, one study examining the prevalence of sedentary behaviors, obesity, and diabetes among the Nurses' Health cohort found statistically significant positive associations between time spent watching TV and risk of obesity, as well as time spent watching TV and risk of type II diabetes.[12] For each 2-hour per day increase in time spent watching TV, there was an associated 23 percent increase in obesity risk and 14 percent increase in risk of type II diabetes.[13]

1.3. mindless eating

Mindless eating is a third factor associated with the American overweight and obesity epidemic. Wansink and Sobal state that the core of mindless eating is an unawareness of how many food-related decisions we actually make on a daily basis, with the majority of these decisions centering on the starting and stopping of eating.[14] In the first of two studies, these researchers found that a sample of college students and adults dramatically underestimated the number of food-related decisions they made on a daily basis, with the average participant estimating they made 14.4 food-and-beverage-related decisions per day, when in actuality they made, on average, 226.7 decisions.[15] In their second study, Wansink and Sobal revealed how external factors can influence our food decisions, finding that participants who ate out of a large snack bowl while viewing a sporting event on television consumed, on average, 31% more than those who ate out of a small snack bowl while viewing this television program.[16] Perhaps the most intriguing finding in Wansink and Sobal's series of studies was that when the large bowl participants were informed of how much more food they consumed compared to those who ate out of a small bowl, 21% denied having eaten more than the small bowl participants.[17] When asked to explain why they ate more, 69% said that if they did it was due to hunger, and only 4% believed they may have eaten more due to the environmental cue of eating out of a larger bowl.[18]

1.4. the role of self-control depletion

The ability to exert self-control is a key factor in the day-to-day food- and eating-related decisions we make, such as resisting the urge to eat fattening or forbidden foods.[19] Baumeister, Vohs, and Tice define self-control as "the capacity for altering one's own responses, especially to bring them in line with various standards such as ideals, values, morals, and social expectations, and to support the pursuit of long-term goals."[20] Extensive literature reviews conducted by Baumeister, Heatherton, and Tice indicate that self-control is a limited resource that can be depleted or exhausted when taxed repeatedly, similar to how a muscle becomes fatigued from repeated use.[21] The analogy between self-control and a muscle also appears to be fitting in the sense that just as a muscle can be strengthened through repeated exertion, it appears that regularly exerting self-control can make this resource more resistant to depletion.[22] However, it also appears that it is fairly easy to deplete one's self-control, with Gailliot and Baumeister stating that a single task requiring the exertion of self-control appears to deplete this limited resource, and that subsequent efforts to exert self-control may be impaired as a result.[23]

There is extensive evidence supporting the conception of self-control as a single, limited resource. For example, Muraven, Collins, and Nienhaus found that participants who exerted self-control in an initial thought suppression task later consumed more alcohol, despite knowing that their driving abilities would subsequently be tested in a simulator, compared to those who initially completed arithmetic problems, a simple task not requiring the exertion of self-control.[24]

One example of how depleted self-control can lead to problematic eating behaviors comes from a series of studies conducted by Vohs and Heatherton, who found that placing tempting and available snack food in close proximity to a group of dieters resulted in greater subsequent consumption of ice cream compared to non-dieters, who were unaffected by the experimental manipulations of being presented with available and close snack food.[25] The significantly greater consumption of ice cream on the part of the dieters was believed to be the result of situational self-control demands – resisting the urge to eat the available unhealthy snack food – depleting their already taxed self-control, since the dieters had the added demand of actively monitoring and regulating their caloric intake.[26]

More recently, researchers have sought to understand and explain how it is that this self-control resource works and what exactly is being depleted, with Gailliot and Baumeister positing that blood glucose is the mechanism, or energy source, behind our ability to exert self-control.[27] These researchers argue that since the brain uses glucose as a source of fuel, effortful and controlled (i.e., executive) cognitive processes likely demand more glucose than simpler and less effortful (i.e., automatic) processes, and that acts requiring the exertion of self-control (e.g., attention and emotion regulation) consume large amounts of glucose.[28]

1.5. interventions to restore depleted self-control

One intervention that has been studied as a potential means to restore depleted self-control is restoring reduced blood glucose levels following a task requiring the exertion of self-control, with Gailliot and colleagues demonstrating that depleted self-control could be restored by having participants consume a glucose-rich beverage, specifically sugar-sweetened lemonade.[29] However, a concern with restoring depleted self-control by increasing blood glucose levels, and thus making more fuel available to the brain, is that fast-acting sugars (i.e., monosaccharides and disaccharides) are found mainly in unhealthy snack foods and sugar-laden drinks, which may not offer the healthiest long-term solution for restoring depleted self-control.[30]

Another intervention that has been shown to restore depleted self-control is mindfulness meditation.[31] The term *mindfulness* refers to paying attention in the present moment to all experiences, good or bad, in a non-judgmental and accepting manner.[32] Cultivating an awareness of each moment, or cultivating mindfulness, is known as mindfulness meditation, which has its roots in Buddhist meditation practices.[33] When practicing mindfulness meditation, one focuses their attention on a particular experience, such as breathing and the various associated sensations throughout the body.[34] Research has demonstrated that a brief (i.e., short-duration, single-application) mindfulness meditation intervention is effective at restoring depleted self-control, with Friese and colleagues demonstrating that even five minutes of mindfulness meditation was effective at restoring experimentally depleted self-control, such that no difference was found in performance on a subsequent task requiring self-control between those who had their self-control depleted and those who did not.[35]

Another example highlighting the positive impact that mindfulness meditation can have on the ability to exert self-control comes from Tang, Tang, and Posner, who found that cigarette smokers who participated in a 2-week mindfulness meditation intervention – for a total of five hours of meditation – experienced a 60% reduction in

smoking, compared to control participants who underwent relaxation training and experienced no smoking reduction.[36] Even more fascinating, Tang and colleagues initially found that, compared to nonsmokers, those who smoked had decreased cerebral blood flow in regions of the anterior cingulate cortex (ACC) and prefrontal cortex (PFC), two brain structures implicated in self-control, but at the conclusion of the intervention, those who practiced mindfulness meditation displayed increased ACC and PFC activity.[37]

1.6. mindful eating

Of particular relevance to this study, *mindful eating*, which is described as a non-judgmental awareness of physical and emotional experiences that arise when eating or when in an environment where food is present, may serve as a useful weight loss or maintenance tool as it fosters an awareness of why one is eating.[38] Self-reported mindful eating has been found to be negatively correlated with body mass index, hinting at the possibility that those with lower BMI tend to be more mindful when eating.[39] Mindful eating also has clinical applications, with Kristeller and Hallett finding that implementation of a 6-week mindful eating and mindfulness meditation intervention among a sample of women meeting diagnostic criteria for binge eating disorder resulted in significant decreases in both the number of weekly binge-eating episodes and level of depression.[40]

1.7. purpose of study

The purpose of the present study was to examine the efficacy of a brief mindfulness meditation intervention at restoring experimentally-depleted self-control and inducing a state of mindfulness among participants that would persist during a subsequent task where food was available. It was hypothesized that the mindfulness meditation intervention would serve to restore depleted self-control, allowing participants who underwent the intervention to more effectively regulate the amount of food consumed (i.e., consume less food) during a subsequent eating task compared to self-control depleted participants who instead completed the non-intervention (i.e., distractor) task. Furthermore, it was hypothesized that the mindfulness meditation intervention would facilitate a state of enhanced mindfulness during the subsequent eating task, resulting in more mindful eating among participants who underwent the intervention compared to those who completed the non-intervention task.

2. Methodology

2.1. participants

Eighty-nine undergraduate students (M_{Age} = 19.00 years, SD_{Age} = 0.92 years, 58 women) were recruited from the psychology subject pool at a small midwestern university and received course credit for their participation.

2.2. materials

Based on the work of Friese and colleagues,[41] an emotion suppression task was used to deplete participants' self-control, with the task consisting of participants viewing a series of five video segments taken from the public domain of YouTube, which were integrated into a single clip lasting 4 minutes and 49 seconds. These video segments were selected on the basis of eliciting emotions of disgust and shock, featuring, for example, footage of fluid being drained from a large blister, as well as of an emergency room patient's dislocated ankle being forced back into the joint. These video segments were viewed at individual computer stations, with the accompanying audio being played through headphones or earbuds.

Prior to experimental data collection, pilot-testing of the emotion suppression task was conducted with 20 participants (M_{Age} = 19.05 years, SD_{Age} = 1.43 years, 14 women). After completing the emotion suppression task, self-control was assessed using the *d2 Test of Attention*,[42] a standardized and extensively-validated test of selective attention and concentration.[43] The *d2 Test of Attention* consists of the characters d and p scattered throughout 14 test rows, with 47 characters per row.[44] Each character is also marked with one to four dashes above and/or below it (i.e., a maximum of two dashes above and two dashes below a given character, for a potential total of four dashes), with the goal being to cross out any d characters with two dashes without making errors of commission (i.e., crossing out any characters other than a d with two dashes) or omission (i.e., failing to cross out d characters with two dashes).[45] Participants are given 20 seconds per row and instructed to work through as many of the items as possible.[46]

The mindfulness meditation intervention consisted of participants listening to an 8-minute and 53-second guided meditation audio segment extracted from the public domain of YouTube, titled "Guided Meditation with Sam Harris – Short Version." The distractor (i.e., non-intervention) task consisted of participants completing a series of connect-the-dot figures forming various objects (e.g., an elephant or a scarecrow). Completion of connect-the-dot figures was selected based on it being a task that is neither boring nor demanding of cognitive resources.[47]

Food consumption, specifically the amount of M&Ms and Skittles candies eaten, was used as a measure of the availability of self-control resources. Each participant was offered an individual cup containing both M&Ms and Skittles, with the starting weight of each cup being approximately 100 grams. Both the starting and final weights of each cup were measured on a digital scale, with the bottom of each cup being numbered so as to match the final weight with the corresponding initial weight to allow for calculation of the amount of candy consumed.

Participants reported how mindful they were while eating the provided candy by completing an online survey. The items featured in this survey were adapted from the *Mindful Eating Questionnaire* (MEQ).[48] The MEQ is a 28-item scale featuring the following five subscales: (1) Disinhibition (e.g., "I stop eating when I'm full even when eating something I love."); (2) Awareness (e.g., "Before I eat I take a moment to appreciate the colors and smells of my food."); (3) External cues (e.g., "I recognize when I'm eating and not hungry."); (4) Emotional response (e.g., "I snack without noticing that I am eating."); and (5) Distraction (e.g., "I eat so quickly that I don't taste what I'm eating.").[49] Nine items from the MEQ were included in this survey and the wording was altered to reflect participants' eating behavior during this experiment alone, with three items coming from the Awareness subscale (e.g., "I noticed the subtle flavors in the food I ate."), three from the Distraction subscale (e.g., "I ate so quickly that I didn't taste what I was eating."), and one item each from the Disinhibition, External cues, and Emotional response subscales.

2.3. procedure

Participants were assigned to one of four experimental conditions: (1) emotion suppression x mindfulness meditation intervention; (2) no emotion suppression x mindfulness meditation intervention; (3) emotion suppression x distractor task; or (4) no emotion suppression x distractor task. There were three timeslots available per data collection session, with up to five participants completing the experiment per timeslot. Counterbalancing was used for each of the three timeslots to control for potential order effects.

First, participants completed the emotion suppression task. Those in the emotion suppression conditions were given the following verbal instructions prior to viewing the video content: "While viewing these clips, please maintain a neutral facial expression and suppress any emotions that may arise. Also, do your best to not look away from the [computer] screen or move in your chair." Those in the no emotion suppression conditions viewed the same series of video segments, but were given the following verbal instructions: "While viewing these clips, please do not attempt to suppress your emotions in any way. Rather, allow your emotions to arise naturally. While we ask that you do your best to not look away from the [computer] screen, you may look away if you find the content to be too disgusting and/or shocking to watch."

After the emotion suppression task, participants then completed either the mindfulness meditation intervention or the distractor task. Prior to listening to the guided meditation audio segment, those undergoing the mindfulness intervention were given the following verbal instructions: "Please leave your headphones or earbuds plugged in. At this time, we are going to have you listen to a 9-minute audio clip. Your only instructions are to listen carefully to the narrator of the clip and do your best to follow along with his instructions." Those who completed the distractor task were given the following verbal instructions prior to beginning the task: "At this time, you may now turn over the stack of papers that are face down on your desks. We are going to have you complete a series of connect-the-dot figures. Your goal when completing these figures should be to work at a comfortable pace and do your best to not make any mistakes, as you are completing the figures in pen. If you feel like taking a break during this task, you may do so."

The subsequent 10-minute eating task was set up as a waiting room scenario, with participants asked to wait in a conference room across the hall while the lab they were currently in was prepared for the final portion of the experiment. Prior to exiting the lab, participants were offered individual cups of M&Ms and Skittles candies, being told that this was being provided as thanks for their participation and to give them something to snack on while they waited in the conference room, rather than wait until the end of the experiment to offer them this reward. A script was not followed when asking participants to move across the hall and when offering them candy, so as not to make the request sound rehearsed and potentially influence their behavior during the eating task. After 10 minutes had passed, participants were brought back into the lab to complete the final portion of the experiment, but asked to leave their cups of candy in the conference room to avoid spilling in the lab. Each cup of candy was then weighed and the amount of candy consumed was recorded.

The final portion of the experiment consisted of participants completing the online mindful eating survey. In addition to completing this 9-item measure, participants completed a series of demographic items.

3. Results

3.1. pilot-test of emotion suppression task

An independent samples t-test was conducted to examine the effectiveness of the emotion suppression task in depleting participants' self-control. A standardized score on the *d2 Test of Attention* was calculated for each participant by subtracting the total number of errors made from the total number of items processed. The results of the t-test indicated that those in the emotion suppression condition performed significantly worse (M = 97.40, SD = 11.77) than those in the no emotion suppression condition (M = 107.50, SD = 9.18), $t(18) = 2.14$, $p = .046$. Thus, the emotion suppression task appeared to be effective at depleting self-control.

3.2. experimental manipulations

The influences of self-control depletion and type of intervention on the amount of candy consumed and self-reported mindful eating were analyzed using a two-way between-subjects MANOVA. This analysis indicated that there was not a significant interaction between self-control depletion and type of intervention, Wilks' $\lambda = .97$, $F(2, 73) = 1.05$, $p = .36$, $\eta_p^2 = .028$. Power to detect the effect was .23. Examination of the one-way MANOVAs revealed that there was not a significant multivariate main effect for self-control depletion, Wilks $\lambda = .96$, $F(2, 73) = 1.52$, $p = .23$, $\eta_p^2 = .040$. Power to detect the effect was .31. However, a significant multivariate main effect was found for the type of intervention, Wilks' $\lambda = .91$, $F(2, 73) = 3.56$, $p = .034$, $\eta_p^2 = .089$. Power to detect the effect was .64. Given the significance of this multivariate main effect, the univariate main effects for type of intervention were examined. No univariate main effect for type of intervention was found for amount of food consumed, $F(1, 74) = 0.004$, $p = .95$, $\eta_p^2 = .000$, power = .050. There was, however, a significant univariate main effect for type of intervention on mindful eating score, $F(1, 74) = 7.18$, $p = .009$, $\eta_p^2 = .088$, power = .75. As indicated by the composite scores from the mindful eating survey, independent of whether self-control was depleted or not, participants who completed the mindfulness meditation intervention reported being significantly more mindful while eating (M = 30.61, SE = .85) compared to those who completed the distractor task (M = 27.52, SE = .78) (see Figure 1). The means and standard deviations for the two dependent variables are presented in Table 1.

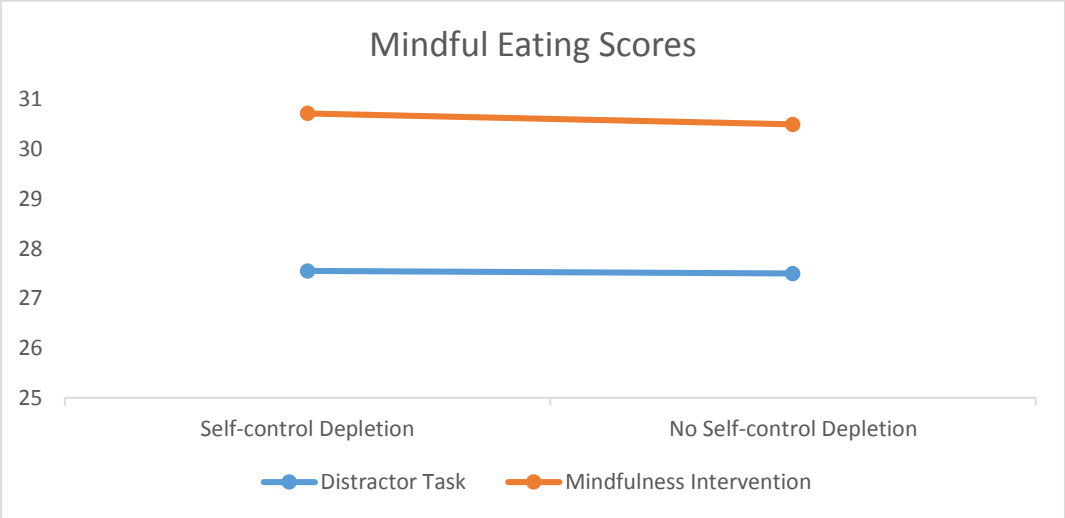

Figure 1. Differences in self-reported mindful eating as a function of self-control depletion and type of intervention received

Table 1. means and standard deviations of food consumption and mindful eating score as a function of self-control depletion condition and type of intervention received

Condition	$M_{\text{Food Consumed}}$ (in g)	$SD_{\text{Food Consumed}}$ (in g)	$M_{\text{Mindful Eating}}$	$SD_{\text{Mindful Eating}}$
self-control depletion x mindfulness meditation	35.33	21.42	30.72	4.00
self-control depletion x distractor task	41.86	22.19	27.55	4.13
no self-control depletion x mindfulness meditation	50.33	18.84	30.50	4.42
no self-control depletion x distractor task	43.25	19.21	27.50	7.04

4. Conclusion

Partial support was provided for the hypothesis that those who underwent the brief mindfulness meditation intervention would consume less food and report being more mindful while eating during the subsequent waiting room scenario compared to those who did not undergo this intervention. While no significant difference was found in the amount of candy consumed, there is a substantial body of research indicating that both brief[50] and longer-term[51] mindfulness meditation interventions aid in controlling food consumption. However, the results of the present study expand upon the literature examining the impact of mindfulness meditation on eating behavior with the finding that a brief mindfulness meditation intervention fostered a state of mindfulness that persisted during a subsequent eating task, as those who underwent the mindfulness meditation intervention reported being significantly more mindful eaters compared to those who instead completed the non-intervention (i.e., distractor) task. The hypothesis that self-control depleted participants who did not subsequently undergo the mindfulness meditation intervention would consume more food than any other group was not substantiated.

One potential reason that we did not find significant differences in food consumption and thus one limitation of the present study could be the specific emotion suppression task used, specifically the suppression of emotion while viewing disgust- and shock-eliciting video content. While prior research[52] suggests that emotion suppression using disgust- and shock-eliciting content is effective at depleting self-control, there are two potential reasons why this self-control manipulation appeared to have no influence on food consumption. The first reason is a temporal issue: since the waiting room scenario began approximately nine minutes after completion of the emotion suppression task, it is possible that the impairment of self-control did not last long enough to influence food consumption. The second reason is that the disgusting nature of the video segments may have inadvertently suppressed participants' desire to consume the provided candy.

A second limitation of the present study is that participants completed the experiment in small groups of up to five people per timeslot. Having participants complete the waiting room scenario in groups (rather than in individual settings) may have affected their food consumption, since research shows that social factors influence eating behaviors. One study demonstrating how the presence of other people can influence eating behavior is that of de Castro and Brewer, in which participants meticulously reported, among other things, everything they ate or drank, the amount they ate or drank, and the number of people eating or drinking with them, with the results revealing respective increases in meal size of 28%, 41%, 53%, 53%, 71%, and 76% associated with eating in the presence of one, two, three, four, five, or six other people.[53]

Despite these limitations, the finding that a brief mindfulness meditation intervention served to foster a prolonged state of mindfulness offers an optimistic outlook regarding the use of mindfulness meditation as a means of controlling food consumption, such as through greater awareness of hunger and satiety cues. Recent work by Jordan and colleagues found that participants who underwent a brief mindfulness intervention subsequently ate 24% fewer calories compared to controls.[54] This evidence suggests that mindfulness meditation may be an effective technique in aiding individuals who are overweight or obese in weight loss, and thus may help curb the prevalence of overweight and obesity not only in America, but across the globe. While prior research has established that brief mindfulness meditation interventions offer salutary outcomes, one question that remains to be answered through future research efforts is the length of time that induced mindfulness persists once the intervention is discontinued. Furthermore, future research should elucidate whether there are potential salutary effects on eating behaviors – and other behaviors requiring the exertion of self-control – that are available through longer-term mindfulness meditation practice.

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